<u>CLAIMS</u>

What is claimed is:

1.   A method of capturing gas phase pollutants in a combustion system having an air

preheater comprising the steps of:

creating a model of the combustion system;

using the model to determine optimal locations to inject particles into the combustion

      system; and

injecting particles into the combustion system at one or more of the determined locations.

2.   The method of claim 1, wherein the gas phase pollutants include sulfur trioxide.

3.   The method of claim 2, wherein the temperature gradients within the air preheater

are modified to increase the rate of sulfur trioxide condensation on ash particles as they

pass through the air preheater and continue to travel downstream.

4.   The method of claim 1, wherein the model is a computer model that models

various parameters in the combustion system.

5.   The method of claim 4, wherein the parameters include temperature patterns, rates

of reaction of components, and condensation reactions.

6.   The method of claim 5, wherein the parameters include the fuel type.

1   7.   The method of claim 5, wherein the parameters include the geometry of the

2   combustion system.

1   8.   The method of claim 1, wherein the combustion system includes a furnace.

1   9.   The method of claim 1, further comprising the step of using the model to

2   determine the concentration and size of the particles to be injected.

1   10.   The method of claim 1, wherein the optimal locations are determined based on

2   where pollutant condensation occurs in the combustion system.

1   11.   The method of claim 1, wherein the optimal locations are determined such that

2   pollutant condensation occurs primarily on the injected particles.

1   12.   A method of capturing gas phase pollutants in a combustion system comprising

2   the steps of:

3   creating a computer model of the combustion system for modeling various parameters in

4   the combustion system, including flow patterns, temperature patterns, and

5   condensation reactions;

6   using the computer model to predict the impact on gas phase pollutants by injecting

7   particles into the combustion system, and to predict the impact on gas phase

8   pollutants by the particle size distribution and the amount of injected particles in

9   order to reduce the pollutants to a desired level;

10   using the computer model to determine one or more optimal locations in the combustion

11   system for the injection of particles;

12   using the computer model to determine an optimal size and amount of particles to be

13   injected; and

14   injecting the determined amount and size of particles into the combustion system at one

15   or more of the determined locations to capture gas phase pollutants in the

16   combustion system.

1   13.   The method of claim 12, wherein the combustion system includes an air

2   preheater.

1   14.   The method of claim 12, wherein the gas phase pollutants include sulfur trioxide.

1   15.   The method of claim 14, wherein the temperature gradients within the air

2   preheater are modified to increase the rate of sulfur trioxide condensation on ash particles

3   as they pass through the air preheater and continue to travel downstream.

1   16.   The method of claim 12, wherein the model takes into account the fuel type used

2   in the combustion system.

1   17.   The method of claim 12, wherein the model takes into account the geometry of

2   the combustion system.

1   18.   The method of claim 12, wherein the optimal locations are determined based on

2   where pollutant condensation occurs in the combustion system.

1   19.   The method of claim 12, wherein the model models rates of reaction of

2   components.

1   20.   A combustion system comprising:

2   a furnace;

3   an air preheater for preheating a combustion air stream in the combustion system;

4   a computer model designed to model the operation of the combustion system, including

5   the impact of the injection of particles into the combustion system; and

6   a particle injector for injecting particles into the combustion system.

1   21.   The combustion system of claim 20, wherein the model is used to determine one

2   or more optimal locations for the particle injector.

1   22.   The combustion system of claim 20, wherein the particle injector injects particles

2   in a location that causes pollutant condensation to occur primarily on the injected

3   particles in order to capture gas phase pollutants in the combustion system.

1   23.   The combustion system of claim 22, wherein the gas phase pollutants include

2   sulfur trioxide.

1 24. The method of claim 23, wherein the temperature gradients within the air

2 preheater are modified to increase the rate of sulfur trioxide condensation on ash particles

3 as they pass through the air preheater and continue to travel downstream.

1 25. The combustion system of claim 20, wherein the computer model models various

2 parameters in the combustion system including temperature patterns, rates of reaction of

3 components, and condensation reactions.

1 26. The combustion system of claim 25, wherein one of the parameters is the fuel

2 type used in the combustion system.

1 27. The combustion system of claim 25, wherein one of the parameters is the

2 geometry of the combustion system.

1 28. The combustion system of claim 20, wherein the computer model is used to

2 determine the concentration and size of the particles to be injected by the particle

3 injector.

1 29. The combustion system of claim 20, wherein the preheater indirectly preheats the

2 air stream using flue gas.

1 30. A method of capturing gas phase pollutants in a combustion system comprising

2 the step of:

3   injecting particles into the combustion system at one or more locations, wherein the size

4   of the particles and the location of the injection are chosen such that pollutant

5   condensation occurs primarily on the injected particles.

1   31.   The method of claim 30, wherein the location of the injection are determined

2   based on where pollutant condensation occurs in the combustion system.

1   32.   The method of claim 30, wherein the chosen location of the injection are

2   determined by measuring gas phase pollutant capture at various injection locations.

1   33.   The method of claim 30, wherein the gas phase pollutants include sulfur trioxide.

1   34.   The method of claim 33, wherein the temperature gradients within the air

2   preheater are modified to increase the rate of sulfur trioxide condensation on ash particles

3   as they pass through the air preheater and continue to travel downstream.

4   35.   The method of claim 30, further comprising the step of creating a model of the

5   combustion system.

1   36.   The method of claim 35, wherein the model is a computer model that models

2   various parameters in the combustion system.

1   37.   The method of claim 36, wherein the parameters include temperature patterns,

2   rates of reaction of components, and condensation reactions.

1 38. The method of claim 37, wherein the parameters include the fuel type.

1 39. The method of claim 37, wherein the parameters include the geometry of the

2 combustion system.

1 40. The method of claim 36, further comprising the step of using the model to

2 determine the concentration and size of the particles to be injected.

1 41. The method of claim 30 , where examples of gas phase pollutants include, but not

2 limited to, Sulfur trioxide, Mercury, and other volatile elements , inorganic and organic

3 compounds.

1 42. A method of capturing gas phase pollutants in a combustion system having an air

2 preheater comprising the step of:

3 performing modifications to the combustion system, wherein the size distribution of the

4   resultant ash particles has an increased population of fine particles below 5

5   microns.

1 43. The method of claim 42, wherein the gas phase pollutants include sulfur trioxide.

1 44. The method of claim 43, wherein the temperature gradients within the air

2 preheater are modified to increase the rate of sulfur trioxide condensation on ash particles

3 as they pass through the air preheater and continue to travel downstream.

1   45.   The method of claim 42, further comprising the step of creating a model of the

2   combustion system.

1   46.   The method of claim 42, wherein the model is a computer model that models

2   various parameters in the combustion system.

1   47.   The method of claim 45, wherein the parameters include temperature patterns,

2   rates of reaction of components, and condensation reactions.

1   48.   The method of claim 45, wherein the parameters include the fuel type.

1   49.   The method of claim 45, wherein the parameters include the geometry of the

2   combustion system.